through the screen and onto the bottom surface of the wafer substrate. The predefined amount of material is enough to deposit the thick film across the wafer substrate such that the thick film is thick enough to allow laser marking of the thick film without the laser penetrating the thick film. Preferably, the amount of material is also not enough to result in a thick film that is thicker than about 5 mils. Most preferably, the amount is such as to result in a thick film that is between about 2 and 3 mils.

After the thick film is applied, in operation **506** a mounting tape is applied to the thick film. Since the mounting tape is applied over the thick film and the thick film adheres well to mounting tape that has a normal adhesiveness level, the mounting tape need not be extra adhesive, such as UV type tape. In other words, a UV type tape that is especially sticky and requires the application of ultraviolet light to release the tape from the wafer is not required. Preferably, a holding structure (or fixture) is utilized to protect the die and/or bumps during the application of the thick film. That is, the holding structure prevents the die and bumps from moving into another structure, such as the screen frame, while the thick film is being applied.

After the thick film is adhered to the mounting tape, in operation **507** the wafer is diced or sawed using conventional techniques. Any suitable cutting device may be utilized to separate the dies from one another. The cutting device must be hard enough to cut through the wafer and thin enough to cut along a thin scribe line between each die. For example, a thin diamond saw that rotates at around 30,000 rpm may be utilized to cut the dies apart.

After the wafer is diced into individual dies, the dies are packaged, or alternatively, mounted onto a printed circuit board (PCB). For example, the individual flip chip devices are inverted onto a PCB such that the bumps of the flip chip device are coupled with traces on the PCB.

The present invention has many advantages. For example, the protective film prevents chipping during the dicing process along the edges of each die. FIG. **3** is a bottom view of a flip chip device **300** that illustrates a substantial reduction in chipping as a result of the application of a protective film **210** to a portion of the bottom surface in accordance with one embodiment of the present invention. As shown, the protective film **210** is applied to a portion of the flip chip device **300**, while the remaining portion is exposed bare silicon **104**. The reduction in chipping may be seen along the edges (e.g., **302**) of the thick film portion **210** of the die. That is, the edges **302** of the thick film portion are relatively smooth. In contrast, the edges (e.g., **304**) along the portion of the die over which the protective film is not applied **104** are rough.

Besides reducing chipping, the present invention has other advantages. By way of example, the reduction in chipping results in significantly less damage to the die as a result of stress cracks being formed from the chipped edges. Additionally, the protective film provides mechanical protection and reduces the likelihood of damage to the die during handling. The protective film also provides electrostatic protection, for example, during handling of the devices.

The protective film provides a surface that may be marked by a laser for identification purposes, for example. Also, a higher contrast mark is more possible on the protective film, as opposed to on a bare silicon bottom surface. Although the protective film is markable with a laser, the protective film is thick enough to not allow the laser to penetrate to the die below the protective film. That is, the protective film is thick enough to protect the die from laser damage. Also, the protective film provides protection from light induced bias. As a result of the light protection, it is less likely that light will cause any functional problems. Additionally, the protective film improves adhesion to a mounting tape, and thus, it is possible to use a mounting tape that is not especially adhesive and does not require a UV curing step to separate the mounting tape from the wafer. Thus, an extra process to cure the mounting tape is not required, and as a result, time and costs associated with the dicing process may be reduced. Also, since the protective film adheres well to the mounting tape, the number of dies that become unstuck from the tape and lost during and after dicing may be reduced.

Although the foregoing invention has been described in some detail for purposes of clarity of understanding, it will be apparent that certain changes and modifications may be practiced within the scope of the appended claims. For example, bumps may be disposed on the electrical contacts of each die subsequent to, rather than prior to, the operation of applying the thick film. Accordingly, the present embodiments are to be considered as illustrative and not restrictive, and the invention is not to be limited to the details given herein, but may be modified within the scope and equivalents of the appended claims.

We claim:

1. A packaged integrated circuit device comprising:

a die having a plurality of electrical contacts on a first surface of the die;

a protective film adhered directly to a back surface of the die, the protective film being thick enough to allow laser marking of the protective film without the laser penetrating to the die,

wherein the protective film has a thickness of between about 1.5 and 5 mils.

2. The packaged integrated circuit device recited in claim 1, wherein the protective film has a thickness between about 2 and 3 mils.

3. The packaged integrated circuit device recited in claim 1 wherein the protective film is a thick film formed from a material that adheres to a mounting tape that is not an especially adhesive type tape.

4. The packaged integrated circuit device recited in claim 1 wherein the protective film is a thick film formed from a material that adheres to a mounting tape that is not a UV type tape.

5. A semiconductor wafer comprising:

a multiplicity of semiconductor dies, each die having a plurality of electrical contacts that are exposed on a first surface of the wafer,

a protective thick film adhered directly to a second surface that is opposite to the first surface of the wafer, the protective film being thick enough to allow laser marking of the protective film without the laser penetrating to the die,

wherein the protective film has a thickness of between about 1.5 and 5 mils.

6. The semiconductor wafer recited in claim 5, wherein the protective film has a thickness between about 2 and 3 mils.

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